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(71)Applicant : MITSUBISHI ELECTRIC CORP
(72)Inventor : YAMAMOTO HITOSHI
MIZUNO MASAHIRO
MATSUMOTO TOSHIO
BABA HIROSHI

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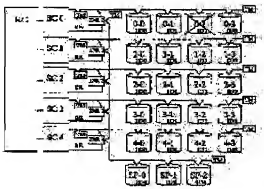
(54) ARRAY-TYPE RECORDING DEVICE, DEVICE SUBSTITUTING METHOD AND HOT STANDBY SYSTEM

(57)Abstract:
PURPOSE: To provide a host standby function without giving excessive controllers.
CONSTITUTION: Drivers/receivers D/R0-D/R4 are connected to respective SCSI controllers SC0-SC4, and standby disk devices SP-0 to SP-2 are connected to them. The respective SCSI controllers access to standby disks by setting a received enable signal for the drivers/receivers to be preferential. ID4-ID6, which are not used, are allocated to the standby disk devices. When the disk device 0-2 breaks down, a RAID controller RC requests that the standby disk device SP-0 is substituted for the disk device 0-2 to the SCSI controller SC0.



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CLAIMS

[Claim(s)]

[Claim 1]While having a selective connection means characterized by comprising the following to connect a reserve device with the above-mentioned channel controller selectively in an array type recorder, the above-mentioned control means, An array type recorder changing into a data access to a reserve device a data access to a storage device which the necessity for the above-mentioned substitution produced while using the above-mentioned selective connection means and connecting a reserve device with a channel controller, when the necessity for substitution with the above-mentioned storage device arises.

A storage device which records data.

A channel controller which connects the above-mentioned storage device.

A control means which controls a data access to a storage device via the above-mentioned channel controller.

A reserve device which substitutes for the above-mentioned storage

device and records data.

[Claim 2]A storage device which records data.
A channel controller which connects the above-mentioned storage device.
A control means which controls a data access to a storage device via the above-mentioned channel controller.
A reserve device which substitutes for the above-mentioned storage device and records data.
While being the array type recorder provided with the above and connecting the above-mentioned reserve device to the above-mentioned channel controller, the above-mentioned control means, When the necessity for substitution with the above-mentioned storage device arises, a data access to a storage device which the necessity for the above-mentioned substitution produced is changed into a data access to a reserve device.

[Claim 3]Have the above-mentioned storage device and a reserve device, respectively, and an identifier a control means, The array type recorder according to claim 1 or 2 changing into a data access to a reserve device a data access to a storage device which the necessity for the above-mentioned substitution produced by changing into an identifier of a reserve device an identifier of a storage device specified with a data-access command.
[Claim 4]A storage device which records data.
A control means which connects the above-mentioned storage device and controls a data access to a storage device.
A reserve device which substitutes for the above-mentioned storage device and records data.
It is the array type recorder provided with the above, two or more owners

of the reserve device are carried out, and two or more reserve devices are used for substitution of one storage device.

[Claim 5]Two or more storage devices which record array type recorder (a) data which has the following elements, (b) A bus to which it is connected to two or more above-mentioned storage devices, and data is transmitted, a reserve device which substitutes for one of the (c) above-mentioned storage devices, (d) An accessing means which requires the above-mentioned selective connection means to connect an alternative device to a bus in order to substitute an alternative device for one of the storage devices while accessing a storage device via a selective connection means and the (e) above-mentioned bus which connect the above-mentioned reserve device to the above-mentioned bus selectively.

[Claim 6]The above-mentioned accessing means is provided with a connection-request means to require that a bus should be connected with a reserve device, and the above-mentioned selective connection means, The array type recorder according to claim 5 having the driver / receiver means for connecting a bus with a reserve device based on a connection request demanded by the above-mentioned connection-request means.

[Claim 7]The array type recorder according to claim 6 with which the above-mentioned bus is provided with two or more signal wires, the above-mentioned reserve device is provided with two or more signal wires corresponding to a signal wire of a bus, and the above-mentioned driver / receiver means connect with the above-mentioned bus a signal wire in which a reserve device corresponds, respectively.

[Claim 8]The array type recorder according to claim 7, wherein the above-mentioned accessing means is provided with a direction output means which outputs data transfer directions to a driver / receiver means

and the above-mentioned driver / receiver means change data transfer directions of two or more signal wires to connect.

[Claim 9]The array type recorder comprising according to claim 5:
An identifier allocation means by which the above-mentioned accessing means assigns an identifier to each storage device and a reserve device.
An alternative accessing means into which an identifier is changed in order to substitute a reserve device for a storage device.

[Claim 10]The array type recorder according to claim 9, wherein the above-mentioned accessing means is provided with a SCSI controller, the above-mentioned bus is a SCSI bus and the above-mentioned identifier is ID used for SCSI.

[Claim 11]The array type recorder comprising according to claim 10:
An identifier storage means into which the above-mentioned alternative accessing means registers change of an identifier.
An access alteration means which changes into a data access by an identifier of an alternative disk a data access by an identifier of a storage device for which it was substituted by referring to an identifier memorized by the above-mentioned identifier storage means.

[Claim 12]While the above-mentioned accessing means accesses a storage device, the necessity for substitution of a storage device is recognized, The array type recorder according to claim 11 which requires connection of a reserve device and a bus from a connection-request means, and is characterized by having a disk control means to require what an identifier for which it is substituted is identified and is memorized to the above-mentioned identifier storage means.

[Claim 13]The above-mentioned disk control means is a RAID controller which constitutes a redundant group with two or more storage devices,

and a RAID controller, The array type recorder according to claim 12 having a restoration means to restore data of a storage device for which it was substituted to a reserve device, based on a redundant group's data.

[Claim 14]The array type recorder according to claim 5, wherein the above-mentioned accessing means is provided with two or more channel controllers which connect two or more storage devices via a bus.

[Claim 15]The array type recorder according to claim 14, wherein the above-mentioned array type recorder is provided with further two or more selective connection means and each selective connection means connects a reserve device with at least one channel controller.

[Claim 16]The array type recorder according to claim 15, wherein two or more above-mentioned selective connection means have connected a common alternative device.

[Claim 17]The array type recorder according to claim 15, wherein the above-mentioned selective connection means has connected one alternative device, respectively.

[Claim 18]A storage device which records data.

A channel controller which connects the above-mentioned storage device.

A control means which controls a data access to a storage device via the above-mentioned channel controller.

A reserve device which substitutes for the above-mentioned storage device and records data.

By a process and the (b) above-mentioned control means which form a selective connection means to connect the above-mentioned alternative device with the device alternate-method (a) above-mentioned channel controller provided with the above selectively, between the above-mentioned channel controller and the above-mentioned alternative device. A process of generating a demand which connects a reserve device with a channel controller to the above-mentioned selective

connection means, (c) It is a process of registering substitution of a storage device by an alternative device, and the process of changing into an access request to an alternative device an access request to a storage device for which it was substituted based on registration of (d) substitution, and has the following processes.

[Claim 19]A storage device which records data.
A channel controller which connects the above-mentioned storage device.
A control means which controls a data access to a storage device via the above-mentioned channel controller.
A reserve device which substitutes for the above-mentioned storage device and records data.
A process of connecting the device alternate-method (a) above-mentioned alternative device provided with the above to the above-mentioned channel controller, (b) It is a process of registering substitution by the above-mentioned alternative device of the above-mentioned storage device, and the process of changing into access to the above-mentioned reserve device access to a storage device for which it was substituted based on the (c) above-mentioned substitution registration, and has the following processes.

[Claim 20]While a process of the above-mentioned device alternate method equipping a storage device and a reserve device with a process of assigning an identifier, respectively, further, and registering the above-mentioned substitution records an identifier of a storage device for which it was substituted, and a reserve device, The device alternate method according to claim 18 or 19, wherein a process of changing the above-mentioned access changes an identifier used for access of a storage device for which it was substituted based on a registered

identifier into an identifier of a reserve device.

[Claim 21]Two or more storage devices which record hot standby system (a) data of an array type recorder which has the following elements, (b) A control means connected to two or more above-mentioned storage devices in order to control access to two or more above-mentioned storage devices, (c) A substitute means which substitutes the above-mentioned reserve storage device for at least one reserve storage device connected to the above-mentioned control means, and at least one storage device judged to be with obstacles in a storage device of the (d) above-mentioned plurality.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention arranges two or more magnetic disk drives to array form, and relates to the hot standby method of the disk array device which accesses data, for example.

[0002]

[Description of the Prior Art]Drawing 18 is a figure showing the conventional disk array device. Especially this figure shows the disk array device which has a hot standby method. Here, a hot standby method means making a reserve system stand by in the state in which service starts are always possible. If the disk unit used now has an obstacle, faulty equipment can be changed to a spare device using a reserve system, and processing can be continued. If a hot standby method is taken, since the reserve system is made to stand by by the state in which service starts

are always possible, an automatic change is possible. Although a hot standby method may be called an alias and a hot stand motorcycle method, it will be hereafter called a hot standby method here.

[0003]In drawing 18, RC is a RAID controller and SC0-SC4 are SCSI controllers. SPC is a spare controller which has the same function as a SCSI controller similarly. 0-0 to 4-3 is a disk unit arranged at two dimensions at array form. TM is a terminator which carries out the termination of the disk unit. SP-0 to SP-3 is the reserve disk unit connected to spare controller SPC. Four sets of disk units are connected to the SCSI controller and the spare controller, respectively. Each controller has connected the disk unit using a SCSI interface. The SCSI interface can connect a maximum of eight devices. A SCSI interface waves to each device and specifies a device using the identification number. Here, a SCSI controller and a spare controller shall have an identification number called ID7. The disk unit connected to each controller assumes that it has ID0, ID1, ID2, and ID3 as an identification number, respectively.

[0004]Next, the hot standby method in the conventional disk array device is explained. For example, when the disk unit 0-2 breaks down, RAID controller RC has attained substitution of a disk unit by separating SCSI controller 0 (SC0) and accessing spare controller SPC instead. When separating SCSI controller 0 and using spare controller SPC instead, the disk unit 0-0 to 0-3 connected is changed to reserve disk unit SP-0 - SP-3. In this case, RAID controller RC memorizes that SCSI controller 0 was transposed to the spare controller to the storage parts store which is not illustrated, and changes all the access instructions to SCSI controller 0 to the access instruction to spare controller SPC.

[0005]Without changing a SCSI controller to a spare controller, as mentioned above, also when only changing a disk unit to a reserve disk

unit, it is possible. For example, when the disk unit 0-2 breaks down, reserve disk unit SP-0 which is in a spare controller instead can be used as an alternative disk. RAID controller RC memorizes that the disk unit 0-2 connected to SCSI controller 0 was changed to reserve disk unit SP-0 connected to the spare controller to the storage parts store which is not illustrated. RAID controller RC changes access to the disk unit 0-2 connected to the SCSI controller to access to reserve disk unit SP-0 connected to the spare controller.

[0006]RAID controller RC restores the broken data of a disk unit to a reserve disk unit, when the broken disk unit is changed to a reserve disk unit. In the disk array device, the block containing the redundant data called a redundant group is distributed and recorded on two or more disk units. Therefore, even when one disk unit breaks down, the broken data of a disk unit can be restored using the data of other disk units which are operating normally. For example, when the disk unit 0-2 breaks down, Since the disk unit 1-2, 2-2, 3-2, and 4-2 form the redundant group with the disk unit 0-2, the data of the disk unit 0-2 broken from the data of these four sets of disks that operate normally can be restored. RAID controller RC writes in the data which read the data of these disk units that operate normally, restored the broken data of the disk unit 0-2, and was restored to the reserve disk unit.

[0007]

[Problem(s) to be Solved by the Invention]Since the conventional disk array device is constituted as mentioned above, in order to attain a hot standby, special spare controller SPC is needed. Only when failure occurs in a disk unit, reserve controller SPC is a preliminary controller used, and is not always used. Thus, by always equipping the disk array device with what is not always used, the device itself will become expensive inevitably.

[0008]It was made in order that this invention might solve the above problems, and it aims at providing the array type recorder and device alternate method which do not need a spare controller, and its hot standby system.

[0009]

[Means for Solving the Problem]While an array type recorder concerning the 1st invention is provided with a selective connection means to connect a reserve device with a channel controller selectively, the above-mentioned control means, When the necessity for substitution with the above-mentioned storage device arises, while using the above-mentioned selective connection means and connecting a reserve device with a channel controller, a data access to a storage device which the necessity for the above-mentioned substitution produced is changed into a data access to a reserve device.

[0010]While an array type recorder concerning the 2nd invention connects the above-mentioned reserve device to a channel controller, the above-mentioned control means, When the necessity for substitution with the above-mentioned storage device arises, a data access to a storage device which the necessity for the above-mentioned substitution produced is changed into a data access to a reserve device.

[0011]An array type recorder concerning the 3rd invention has the above-mentioned storage device and a reserve device, respectively, and an identifier a control means, By changing into an identifier of a reserve device an identifier of a storage device specified with a data-access command, a data access to a storage device which the necessity for the above-mentioned substitution produced is changed into a data access to a reserve device.

[0012]An array type recorder concerning the 4th invention is carrying out two or more owners of the reserve device, and uses two or more reserve

devices for substitution of one storage device.

[0013]An array type recorder concerning the 5th invention has the following elements.

(a) A bus to which it is connected to two or more storage devices which record data, and a storage device of the (b) above-mentioned plurality, and data is transmitted, (c) While accessing a storage device via a selective connection means and the (e) above-mentioned bus which connect selectively to the above-mentioned bus a reserve device and the (d) above-mentioned reserve device which substitute for one of the above-mentioned storage devices, An accessing means which requires the above-mentioned selective connection means to connect an alternative device to a bus in order to substitute an alternative device for one of the storage devices.

[0014]The above-mentioned accessing means is provided with an array type recorder concerning the 6th invention, and a connection-request means to require that a bus should be connected with a reserve device the above-mentioned selective connection means, Based on a connection request demanded by the above-mentioned connection-request means, it has the driver / receiver means for connecting a bus with a reserve device.

[0015]It has a signal wire of plurality [recorder / concerning the 7th invention / array type / bus / above-mentioned], the above-mentioned reserve device is provided with two or more signal wires corresponding to a signal wire of a bus, and the above-mentioned driver / receiver means connect with the above-mentioned bus a signal wire in which a reserve device corresponds, respectively.

[0016]An array type recorder concerning the 8th invention is provided with a direction output means by which the above-mentioned accessing means outputs data transfer directions to a driver / receiver means, and the above-mentioned driver / receiver means change data transfer

directions of two or more signal wires to connect.

[0017]An array type recorder concerning the 9th invention was provided with an identifier allocation means by which the above-mentioned accessing means assigns an identifier to each storage device and a reserve device, and an alternative accessing means into which an identifier is changed in order to substitute a reserve device for a storage device.

[0018]As for an array type recorder concerning the 10th invention, the above-mentioned accessing means is provided with a SCSI controller, the above-mentioned bus is a SCSI bus, and the above-mentioned identifier is characterized by being ID used for SCSI.

[0019]When the above-mentioned alternative accessing means refers to an identifier memorized by an identifier storage means which registers change of an identifier, and the above-mentioned identifier storage means, an array type recorder concerning the 11th invention, It had an access alteration means which changes into a data access by an identifier of an alternative disk a data access by an identifier of a storage device for which it was substituted.

[0020]An array type recorder concerning the 12th invention recognizes the necessity for substitution of a storage device while the above-mentioned accessing means accesses a storage device, Connection of a reserve device and a bus was required from a connection-request means, and it had a disk control means to require what an identifier for which it is substituted is identified and is memorized to the above-mentioned identifier storage means.

[0021]An array type recorder concerning the 13th invention is a RAID controller which constitutes a redundant group with two or more storage devices, and the above-mentioned disk control means a RAID controller, Based on a redundant group's data, it has a restoration means to restore

data of a storage device for which it was substituted to a reserve device.

[0022]An array type recorder concerning the 14th invention is provided with two or more channel controllers to which the above-mentioned accessing means connects two or more storage devices via a bus.

[0023]The 15th invention **** array type recorder is provided with further two or more selective connection means, and each selective connection means connects a reserve device with at least one channel controller.

[0024]An array type recorder concerning the 16th invention has connected an alternative device with two or more above-mentioned common selective connection means.

[0025]As for an array type recorder concerning the 17th invention, the above-mentioned selective connection means has connected one alternative device, respectively.

[0026]A storage device with which a device alternate method concerning the 18th invention records data, A channel controller which connects the above-mentioned storage device, and a control means which controls a data access to a storage device via the above-mentioned channel controller, In a device alternate method in an array type recorder provided with a reserve device which substitutes for the above-mentioned storage device and records data, it has the following processes.

(a) A selective connection means to connect the above-mentioned alternative device with the above-mentioned channel controller selectively, by a process and the (b) above-mentioned control means which are established between the above-mentioned channel controller and the above-mentioned alternative device. A process of generating a demand which connects a reserve device with a channel controller to the above-mentioned selective connection means, (c) A process of registering substitution of a storage device by an alternative device, a

process of changing into an access request to an alternative device an access request to a storage device for which it was substituted based on registration of (d) substitution.

[0027]A storage device with which a device alternate method concerning the 19th invention records data, A channel controller which connects the above-mentioned storage device, and a control means which controls a data access to a storage device via the above-mentioned channel controller, In a device alternate method in an array type recorder provided with a reserve device which substitutes for the above-mentioned storage device and records data, it has the following processes.

(a) A process of connecting the above-mentioned alternative device to the above-mentioned channel controller, a process of registering substitution by the above-mentioned alternative device of the (b) above-mentioned storage device, a process of changing into access to the above-mentioned reserve device access to a storage device for which it was substituted based on the (c) above-mentioned substitution registration.

[0028]While a process of a device alternate method concerning the 20th invention equipping a storage device and a reserve device with a process of assigning an identifier, respectively, further, and registering the above-mentioned substitution records an identifier of a storage device for which it was substituted, and a reserve device, A process of changing the above-mentioned access changes an identifier used for access of a storage device for which it was substituted based on a registered identifier into an identifier of a reserve device.

[0029]A hot standby system of an array type recorder concerning the 21st invention has the following elements.

(a) A control means connected to two or more above-mentioned storage devices in order to control access to two or more storage devices which

record data, and a storage device of the (b) above-mentioned plurality, (c) A substitute means which substitutes the above-mentioned reserve storage device for at least one reserve storage device connected to the above-mentioned control means, and at least one storage device judged to be with obstacles in a storage device of the (d) above-mentioned plurality.

[0030]

[Function]In the array type recorder in the 1st invention, since a selective connection means connects a reserve device with a channel controller when failure arises in a storage device, the preliminary controller for controlling a reserve device is unnecessary. That is, in order that a selective connection means may connect a reserve device to the channel controller which controls the usual storage device, the reserve device operates by control from the usual channel controller.

[0031]In the array type recorder in the 2nd invention, since a reserve device is connected to the channel controller which is controlling the usual storage device, the preliminary channel controller which controls a reserve device is unnecessary. That is, it is connected to the channel controller which controls the usual storage device, and a reserve device controls a control means, distinguishing a usual storage device and reserve device.

[0032]In the array type recorder in the 3rd invention, When the identifier is given to the storage device and the reserve device and substitution arises in the 1st and the 2nd invention which were mentioned above, Since a control means performs substitution of a storage device and a reserve device using the identifier given to the storage device and the reserve device, even when a usual storage device and reserve device are intermingled and connected to the same channel controller, both can be distinguished, respectively and it can access them.

[0033]In the array type recorder in the 4th invention, When substituting

for one storage device, in order to use two or more reserve devices, when restoring the data of the storage device broken to the reserve device, access concentrated to a reserve device can be distributed to two or more reserve devices. By performing read-out from two or more reserve devices, also when the broken storage device is replaced and it copies the data of a reserve device to a new storage device, Compared with the case where data is read from one reserve device, it becomes possible to process at high speed.

[0034]In the array type recorder in the 5th invention, it is substituted for a storage device by the accessing means with a reserve device. A selective connection means connects a reserve device to a bus based on the alternative demand from an accessing means. Therefore, a preliminary controller becomes unnecessary in order to control a reserve device.

[0035]A reserve device is connected to a bus, only when the accessing means is provided with the connection-request means and there is a connection request by a connection-request means. A reserve device is connected to a bus, when a driver/receiver exists in a selective connection means and there is a connection request in it.

[0036]The bus comprises two or more signal wires, and when the driver/receiver which controls connection of two or more signal wires exist, the connection-request means can connect a reserve device to a bus with only outputting a request to a driver/receiver.

[0037]The accessing means has a direction output means.

A driver/receiver connects a signal wire with the specified directivity.

[0038]The storage device and the reserve device are having the identifier assigned, respectively.

By changing an identifier, an alternative accessing means changes access

of a device dynamically.

[0039]The SCSI interface is used and this invention can be applied to the storage device using this SCSI interface.

[0040]An alternative accessing means changes access to a storage device into access to an alternative device by memorizing an identifier and referring to the memorized identifier.

[0041]The accessing means is provided with the disk control means.

An alternative demand is published when a disk control means detects abnormalities to a storage device.

While memorizing the identifier substituted for the alternative accessing means based on this alternative demand, access to the storage device for which it was substituted is changed into access to an alternative device.

[0042]A disk control means is a RAID controller.

This invention can be applied also when building a RAID system.

[0043]The above-mentioned accessing means is provided with two or more channel controllers.

Since each channel controller connects two or more storage devices, this invention is applicable to a two-dimensional array type recorder.

[0044]Two or more selective connection means exist, and each selective connection means is connected to one reserve device while being connected to at least one channel controller. Thus, substitute reliability is raised by having two or more selective connection means to a two-dimensional array type recorder.

[0045]When two or more selective connection means are connected in series, a common reserve device can be shared.

[0046]When two or more selective connection means have connected one

reserve device, respectively, a two or more sets substitute means can be provided.

[0047]In the device alternate method of this invention, Access to a storage device is changed into access to a reserve device by registering having connected the reserve device with the channel controller selectively, and the reserve device having been connected with the channel controller, and having been substituted for the storage device.

[0048]In this invention, a reserve device is connected with a channel controller, and in substituting, it registers the substitution.

Therefore, access to future storage devices is changed into access to a reserve device.

[0049]This invention registers substitution by an identifier and changes access to a storage device into access of a reserve device.

[0050]In the hot standby system of this invention, Since at least one reserve storage device is connected to the control means and a substitute means substitutes a reserve storage device for a storage device to produce failure in a storage device, a controller special to reserve storage devices is not needed.

[0051]

[Example]

Example 1. drawing 1 is a figure showing one example of the disk array device concerning this invention. In the figure, the same numerals as the figure shown by the conventional example show the same or considerable portion.

Here, the explanation is omitted.

A point different as greatly as the former is a point that spare controller SPC does not exist. In a figure, D/R is the driver/receiver which connects a reserve disk unit with a SCSI controller selectively. RE is a receipt

enable signal which operates a driver/receiver and connects a reserve disk unit with a SCSI controller. In each SCSI controller, identification number ID7 is **********.

being alike -- identification number ID0, ID1, ID2, and ID3 shall be attached

[0052]The SCSI interface can identify a total of eight devices. Therefore, an identification number called ID4, ID5, and ID6 is attached to reserve disk unit SP-0, SP-1, and SP-2 here.

[0053]A driver/receiver is connected to each SCSI controller, and spare-disks SP-0 - SP-2 are connected to the point of these drivers / receiver. Each SCSI controller accesses spare disks by making significant the receipt enable signal RE to a driver/receiver. As mentioned above, the identification number which is not used with a SCSI interface is assigned to spare disks. Therefore, even when a disk unit and a reserve disk unit are connected to the same SCSI controller by using this identification number, it becomes possible to distinguish both and to access them.

[0054]Next, drawing 2 is a block diagram of the SCSI controller shown in drawing 1. A SCSI controller accesses data to a disk unit via the bus 50, and it substitutes a reserve disk unit for the broken disk unit by connecting a reserve disk unit to the bus 50 using a driver/receiver. Each SCSI controller is provided with the connection-request output means 40 which requires connection of a reserve disk unit of a driver/receiver. The SCSI controller is provided with the direction output means 30 which outputs the direction of transfer of data to a driver/receiver. A SCSI controller assigns an identification number to a disk unit by the identifier allocation means 20, and it assigns the identification number which was not used for the disk unit in reserve to a disk unit. The alternative

accessing means 10 substitutes a reserve disk unit for a disk unit by changing the identifier which the identifier allocation means 20 assigned to the disk unit and the reserve disk unit. This alternative accessing means 10 is provided with the identifier storage means 12 which memorizes the changed identifier. When the information on **** that the identifier was changed into this identifier storage means 12 is memorized, By changing the identifier of the access request which receives from RAID controller RC, the alternative accessing means 10 changes the access request to the broken disk unit into the access request to a reserve disk unit.

[0055]Next, the case where the disk unit 0-2 breaks down is made into an example, and it explains below. When the disk unit 0-2 breaks down, a RAID controller (RC) requires the following two demands from SCSI controller 0, as shown in drawing 3.

The demand 1. receipt enable signal RE is made significant, and a driver / receiver 0 is operated.

Reserve disk unit SP-0 is used instead of the demand 2. disk unit 0-2.

[0056]As shown in drawing 4 to two demands from this RAID controller RC, SCSI controller 0 operates as follows.

(1) Make the receipt enable signal RE significant.

(2) Restore data using the data of the disk unit 1-2, 2-2, 3-2, and 4-2 to reserve disk unit SP-0, and write in the restored data.

(3) Memorize the identification number (ID4) of reserve disk unit SP-0 to an identifier storage section to identification number ID of the broken disk unit 0-2. And the access request to the disk unit 0-2 is published to reserve disk unit SP-0 after that using the conversion to ID4 memorized from identification number ID2.

[0057]In the example shown in drawing 2, although the case where the alternative accessing means 10 is formed in the inside of a SCSI

controller is explained, this alternative accessing means 10 may exist in the inside of RAID controller RC. When the alternative accessing means 10 exists in the inside of RAID controller RC, Access outputted to a SCSI controller from RAID controller RC is already generated as an access request to a reserve disk unit, and a SCSI controller can be accessed to a reserve disk unit according to the access request.

[0058]Next, the composition of a driver / receiver D/R is explained using drawing 5. Drawing 2 is a figure showing the composition of a driver/receiver. This driver/receiver are formed to the signal wires of each used for a SCSI interface. For example, when a SCSI interface comprises 18 signal wires in all, the driver/receiver which showed drawing 5 are formed 18 pieces. The switch SW is formed in the driver/receiver. The switch SW inputs the receipt enable signal RE from SCSI controller SC. The switch SW inputs direction signal DIR out of the signal wire which constitutes the SCSI interface. A DIR signal shows the direction of a signal. That is, it is a signal which shows whether data is sent in the direction of a disk unit from the SCSI controller, or it is sent in the direction of a SCSI controller from the disk unit.

[0059]The switch SW operates, only when the receipt enable signal RE is significant. The switch SW turns ON either the signal D1 or the signal D2 according to direction signal DIR, when the receipt enable signal RE is significant. When direction signal DIR shows the direction of a disk unit from the SCSI controller, the signal D2 is set to ON. On the contrary, when direction signal DIR shows the direction of a SCSI controller from the disk unit, the signal D1 is set to ON.

[0060]Drawing 6 is a figure showing other examples of a driver/receiver mentioned above. In the example mentioned above, the case where the signal D turned on or turned off according to direction signal DIR shows a direction is shown in the example shown in drawing 6 although the

direction was shown using the signal D1 and the signal D2. Drawing 7 is a figure showing other examples of a driver/receiver. The driver/receiver which mentioned above are formed about each signal wire which constitutes the SCSI interface. Therefore, in order to make the circuit structure as small as possible, the switch SW which can be communalized is taken out. Only the one switch SW is formed and supplies the signal D1 and the signal D2 from this switch SW to the driver/receiver formed corresponding to each signal wire.

[0061]It enables a driver/receiver to connect a reserve disk unit to a SCSI controller selectively by the above operation. It becomes possible to access the reserve disk unit connected by the driver/receiver completely like the usual disk unit. However, a different point has an identification number with respectively peculiar a disk unit and a reserve disk unit, and a SCSI controller is a point accessed while distinguishing a disk unit and a reserve disk unit using this peculiar identification number. As mentioned above, according to this example, it becomes possible to attain a hot standby, without having a special reserve controller.

[0062]In the example 2. above-mentioned example 1, although the case where a driver/receiver was connected to each of each SCSI controller was shown, the case where a driver/receiver is connected to one SCSI controller as shown in drawing 8 may be sufficient.

[0063]In drawing 8, the case where connect a driver/receiver to SCSI controller 4, and three reserve disk units are connected to this driver/receiver is shown. When the disk unit 4-0 breaks down, it is required that RAID controller RC should substitute reserve disk unit SP-0 for the disk unit 4-0 to SCSI controller 4.

[0064]When the disk unit 3-3 breaks down, RAID controller RC substitutes reserve disk unit SP-1 connected to SCSI controller 4 for the disk unit 3-3 connected to SCSI controller 3. When reserve disk unit SP-0

is substituted for the disk unit 4-0 in this way and reserve disk unit SP-1 is substituted for the disk unit 3-3, access to SCSI controller 4 will compete. In a disk array device, data is distributed and recorded on two or more disk units including redundant data. Therefore, the case where he would like to access simultaneously occurs to the disk unit 3-3 and the disk unit 4-3. Reserve disk unit SP-1 is substituted for the disk unit 3-3, and this reserve disk unit SP-1 is connected to SCSI controller 4 via the driver/receiver. Therefore, access to the disk unit 4-3 and reserve disk unit SP-1 will compete. Thus, when access competes, after keeping one access waiting in the inside of SCSI controller 4 and completing access of another side, access kept waiting is performed. Or it may be made to perform not ordering of access by SCSI controller 4 but ordering by RAID controller RC.

[0065]In the example 3. above-mentioned example 1 and Example 2, the reserve disk unit was explained when connecting it with three-set series, but the case where a reserve disk unit is connected in parallel via a driver/receiver as shown in drawing 9 may be sufficient. Drawing 9 has three a driver/receivers.

The example which connected one reserve disk unit at a time is shown to each driver/receiver.

ID4 is used for all the identification numbers of a reserve disk unit in this example. Therefore, since ID5 and ID6 are intact as an identification number, it is also possible to connect the reserve disk unit of ID5 and ID6 in series further to the reserve disk unit of ID4. Although not shown in drawing 9, to SCSI controller 3 and SCSI controller 4, a driver/receiver is formed, and it does not matter even if it connects a reserve disk unit.

[0066]Thus, by making a reserve disk unit parallel and connecting with each SCSI controller separately, When the disk unit connected to each SCSI controller breaks down, the reserve disk unit connected to the SCSI

controller to which the broken disk unit was connected can be used as an alternative disk unit. Therefore, as shown in Example 2 mentioned above, the opportunity for two or more accesses to compete simultaneously decreases to the same SCSI controller.

[0067]In the example 4. above-mentioned examples 1-3, although the case where a preliminary controller was lost using a driver/receiver was explained, in this example, the case where a preliminary controller is lost without using a driver/receiver is explained.

[0068]Drawing 10 is a figure showing the composition of the disk array device in this example. A reserve disk unit is connected to the usual disk unit and series in this example. For example, reserve disk unit SP-0 is connected to SCSI interface 0. Similarly, reserve disk unit SP-1 is connected to SCSI controller 2. Reserve disk unit SP-0 and SP-1 set an identification number to ID4. Therefore, it is possible to distinguish with other disk unit and this identification number. For example, when the disk unit 0-1 breaks down, reserve disk unit SP-0 connected to same SCSI controller 0 is substituted.

[0069]Since the reserve disk unit is not connected to SCSI controller 3 when the disk unit 3-3 breaks down, reserve disk unit SP-1 connected to SCSI controller 2 is substituted. Since the SCSI controller connected is the same when substituting reserve disk unit SP-0 for the disk unit 0-1, substitution processing is performed when SCSI controller 0 changes access to ID1 into access of ID4. On the other hand, in substituting reserve disk unit SP-1 for the disk unit 3-3, in RAID controller RC, it substitutes for "the disk unit 3-3 connected to SCSI controller 3" "reserve disk unit SP-1 connected to SCSI controller 2." In substituting reserve disk unit SP-1 for the disk unit 3-3, as Example 2 described, two or more accesses compete to SCSI controller 2. In this case, in SCSI controller 2 inside, sequence control for canceling that competition is performed. Or

sequence control for canceling competition in RAID controller RC is performed.

[0070]Although the case where two reserve disk units were formed was explained, you may make it form a reserve disk unit to each SCSI controller in the example 5. above-mentioned example 4 like [in the case of being shown figure 11]. Although not illustrated, two or more reserve disk units may be connected in series to each SCSI controller. For example, considering the case of SCSI controller 0, since ID5 and ID6 are still intact as an identification number, it is possible to connect two more reserve disk units to SCSI controller 0.

[0071]In the example 6. above-mentioned examples 1-5, when there was a SCSI controller in several **, intermediary explanation was given, but the case where a SCSI controller accepts one set and exists as shown in drawing 12 and drawing 13 may be sufficient. When only one SCSI controller exists, a redundant group is formed by the disk unit 0-0 to 0-3. Thus, a disk array device as well as the system mentioned above can be constituted. And when one belonging to these redundant groups of disk units breaks down, and shown in drawing 12, it can substitute using the reserve disk unit connected to a driver / Lesh Bar. In the case of drawing 13, with the reserve disk unit connected to the same SCSI controller, can be and it can substitute.

[0072]Example 7. drawing 14 shows the case where a disk unit is arranged by the three dimension. Also in the case of the disk array device with which the disk unit has been arranged at the three dimension, substitution to a reserve disk unit can be performed. For example, when disk unit 4-0-0 breaks down in drawing 14, reserve disk unit SP-0 can be substituted. When disk unit 4-0-1 breaks down further, it can substitute using reserve disk unit SP-1. Although the example shown in drawing 14 applies to a three dimension what was shown in drawing 1, it is possible

for it to be adapted also to the disk array device arranged similarly at the three dimension in other methods shown in Examples 1-5 mentioned above.

[0073]In the example 8. above-mentioned examples 1-5, when a reserve disk unit was substituted for the broken disk unit and it substituted for 1 to 1, it explained, but this example explains the case where two or more reserve disk units are substituted for one broken disk unit.

[0074]In drawing 11 mentioned above, when the disk unit 1-3 breaks down, this example is used and substituted for two reserve disk units, reserve disk unit SP-1 and SP-2. Drawing 15 is a mimetic diagram substituted for the disk unit 1-3 which the obstacle generated by reserve disk unit SP-1 and SP-2. The data A and B in the disk unit 1-3 is divided and restored to reserve disk unit SP-1 and SP-2, respectively. For example, the first half of the data of a disk unit is restored to reserve disk unit SP-1, and the latter half is restored to SP-2. When the following obstacle occurs and the disk unit 1-2 breaks down in such the state, the data of the first half of the disk unit 1-2 is restored to reserve disk unit SP-2, and the data of the latter half of the disk unit 1-2 is restored to reserve disk unit SP-1. Thus, also when returning data again after exchanging the broken disk while restoration time decreases by dividing into two or more reserve disk units, and restoring to them, when restoring the broken data of a disk unit, it becomes possible to return to the disk for which data was exchanged at high speed. Since it restores to the remaining portion when other disks break down, as it was shown in drawing 7, even when dividing and restoring, it can prevent the storage area of a reserve disk unit becoming useless.

[0075]Drawing 16 is a figure showing other examples of this example. In drawing 15, although the case where a disk first half and the latter half were restored to each disk unit was explained, in drawing 16, the case

where data is restored per the block unit of the disk unit which the obstacle generated, or address is shown. In drawing 16, 1 to 8 is the block or address of a disk unit which the obstacle generated. The data of odd blocks or odd addresses is restored to reserve disk unit SP-1. Reserve disk unit SP-2 restores the data of the block of the even number of a disk unit, or even addresses which the obstacle generated.

[0076]Although not illustrated, how to divide the data of the broken disk and restore can be considered. For example, or it divides per cylinder, and it divides into a track unit, various split methods of dividing or dividing into a file basis per directory can be considered.

[0077]Example 9. drawing 17 is a figure showing other examples in the case of dividing the data of the broken disk and restoring. The composition shown in drawing 17 is the same as that of what was explained by the conventional example. A different point from the former is a point for which two or more reserve disk units are substituted, when one disk unit breaks down. For example, when the disk unit 0-2 breaks down, it substitutes by reserve disk unit SP-0 and SP-1.

[0078]In the example 10. above-mentioned example, although the case where one set of a disk unit was restored using two reserve disk units was explained, you may substitute for the number of the reserve disk units to be used not only using two sets but using three sets, four sets, or the number beyond it.

[0079]In the example 11. above-mentioned example, although the case where a SCSI interface was used was explained, this invention can be applied, not only when using a SCSI interface, but when using other interfaces.

[0080]Although not stated [especially the example 12. above-mentioned example], when a magnetic disk drive is used as a disk unit, Or when using an optical disk unit, it is possible to be able to consider the case

where a compact disk device is used etc. and to apply this invention especially regardless of the kind of storage device. The case where make the storage device with which these kinds differ intermingled, and it is used may be sufficient. Although the case of the disk unit was made into the example and explained in the above-mentioned example, when it constitutes an array type recorder using the storage device which can memorize not only a disk unit but data, it is possible to apply this invention.

[0081]

[Effect of the Invention]According to the 1st - the 3rd invention, a hot standby can be provided as mentioned above, without having an excessive controller for controlling spare disks.

[0082]By the 1st invention, a reserve device is connected especially selectively.

Therefore, when the necessity for substitution arises, the special hardware which connects a reserve device is not needed.

[0083]In the 2nd invention, the reserve device is usually connected to the channel controller.

Therefore, when the necessity for substitution arises, the special hardware which connects a reserve device is not needed.

[0084]According to the 3rd invention, since substitution is performed by changing an identifier, substitution can carry out dynamically with software or firmware.

[0085]According to the 4th invention, since the data of the disk broken using two or more spare disks is restored, restoration of data or the time of a return of data can be shortened.

[0086]In this invention, a selective connection means connects a reserve

device by the request of an accessing means.

Therefore, the special controller for controlling a reserve device is not needed.

[0087]According to this invention, easy composition called a driver/receiver can constitute a selective connection means.

[0088]According to this invention, two or more signal wires are easily connectable with a driver/receiver.

[0089]According to this invention, a direction of transfer can be specified with a direction output means, and a driver/receiver, and a signal wire can be connected.

[0090]According to this invention, since each device is identified using an identifier, it can substitute by change of an identifier.

[0091]According to this invention, this invention is applicable to the system provided with the SCSI interface.

[0092]According to this invention, the access request to a storage device can be changed into the access request to a reserve device by easy operation called memory and its reference of an identifier.

[0093]According to this invention, by a disk control means, when the necessity for substitute occurs, it can substitute for a storage device promptly.

[0094]According to this invention, this invention is applicable to a RAID system.

[0095]According to this invention, this invention is applicable to the two-dimensional or three-dimensional array type recorder which comprises two or more channel controllers.

[0096]According to this invention, since two or more selective connection means exist, the channel controller to connect can be chosen selectively.

[0097]According to this invention, even when two or more selective connection means exist, two or more selective connection means can be connected to a common reserve device.

[0098]In this invention, a reserve device is separately connected to two or more selective connection means, respectively.

Therefore, it can substitute selectively.

[0099]In this invention, an alternative device is connected based on the connection request of an alternative disk, and the result is registered.

Therefore, the access request to the storage device for which it was substituted can be changed into the access request of a reserve device, without needing a special controller.

[0100]In this invention, even when a reserve device is connected to a channel controller, it passes through the work of substitute registration.

Therefore, access to the storage device for which it was substituted can be changed into access to a reserve device.

[0101]According to this invention, special hardware is not needed but it can substitute attaining substitution using an identifier.

[0102]According to the hot standby system of this invention, it can substitute, without needing a special controller.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 2]It is a figure showing the composition of the SCSI controller by one example of this invention.

[Drawing 3]It is a flow chart figure of the RAID controller by one example of this invention.

[Drawing 4]It is a flow chart figure of the SCSI controller by one example of this invention.

[Drawing 5]It is a figure showing the composition of the driver/receiver by one example of this invention.

[Drawing 6]It is a figure showing the composition of the driver/receiver by one example of this invention.

[Drawing 7]It is a figure showing the composition of the driver/receiver by one example of this invention.

[Drawing 8]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 9]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 10]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 11]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 12]It is a figure showing the composition of the disk array device of the one-dimensional array by one example of this invention.

[Drawing 13]It is a figure showing the composition of the disk array device of the two-dimensional array by one example of this invention.

[Drawing 14]It is a figure showing the composition of the disk array device of the three dimensional array by one example of this invention.

[Drawing 15]It is a figure showing the concept in the case of restoring data in two or more reserve disk units twisted in the one example of this invention.

[Drawing 16]It is a figure showing the concept in the case of restoring data in two or more reserve disk units twisted in the one example of this

invention.

[Drawing 17]It is a figure showing the composition of the disk array device by one example of this invention.

[Drawing 18]It is a figure showing the composition of the conventional disk array device.

[Description of Notations]

0-0 - 4-3 disk unit, a RC RAID controller, SC SCSI controller, TM [Receipt enable signal and SP-0 - SP-2 reserve disk unit, and DIR / Identification number.] A direction signal, and ID0-ID6 A terminator and D/R A driver/receiver, and RE